NEWSLETTER

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Newsletter
Volume 19 Number 3
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AUSTRALIAN SOCIETY FOR LIMNOLOGY

The Australian Society for Limnology is an association of over 425 people with professional or amateur interests related to Australian inland waters. Since its inception in 1961 the Society has played an important role in fostering limnological work in this country. The ASL promotes liaison between limnologists in academic, private and governmental institutions and has a vested interest in the conservation of aquatic and related resources. Annual congresses are held near centres of limnological interest, and the programme includes scientific sessions, field excursions and social activities.

The ASL produces a *Newsletter* with notes on activities, articles of general interest, book reviews and congress announcements; a *Bulletin* of original scientific papers and occasional *Special Publications*. A further publication is the *Directory of Australian Limnologists*.

Membership applications are welcomed; four classes of subscribing membership are available:

Ordinary members	$10.00 p.a.
Student members	$4.00 p.a.
Institutional members	$10.00 p.a.
Sustaining members	Fees on application

Members are entitled to receive the Australian Journal of Marine and Freshwater Research at the reduced rate of $15.00 p.a.

Membership subscriptions cover the period 1 July to 30 June but subscriptions for Aust. J. mar. Freshwat Res. cover the period 1 January to 31 December.

Enquiries relating to membership should be addressed to:

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Secretary, ASL.,
C/- Department of Chemistry,
Caulfield Institute of Technology,
P.O. Box 197,
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ASL Executive 1980-81

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EDITORIAL

On page 7 of this issue are the remaining abstracts of papers presented at the Narooma Conference. The first one printed is of Rod Oliver's paper *A Biological Interpretation of Phytoplankton Photosynthetic Production as a Function of Light Absorbance*. For this paper Rod became the first receipient of the new A.S.L. Student Award. This award is to be presented annually for the best paper read at the A.S.L. Conference by a student, or an ex-student reporting work carried out whilst he was a student. I was not at the Narooma Conference but I understand that the quality of papers competing for this award was very high. The selection committee were instructed to consider both the presentation and content of the papers. Congratulations Rod on being the best in a good lot. I hope that the high standards established this year will be the norm for future Conferences.

Robert White

NEWS AND VIEWS

Membership Details

Enclosed with this Newsletter is a membership up-date form. If any details relating to your membership, e.g. name, address, research interests, etc. have changed since the last membership directory (1979) please complete the form promptly and return to Margaret Hart.

A.S.L. Subscription

If you haven't done so yet, please pay your 1981/82 subs. Remember, that if you wish to receive the Australian Journal of Marine and Freshwater Research in 1982 you must pay the augmented subscription before the end of November 1981.

Gambusia in the Murray

Lance Lloyd is studying the impact of the introduced mosquito fish, *Gambusia affinis*, on the smaller native fishes of the River Murray. This work is for a M.Sc. degree and is being supervised by Keith Walker. Lance would like to hear from other A.S.L. members with an interest or knomledge of *Gambusia* in the River Murray or other river systems. Lance is in the Department of Zoology, University of Adelaide, Adelaide, S.A. 5001.

Macroinvertebrate Voucher System

The Victorian Chapter of the A.S.L. is instituting an identification system for groups for which adequate taxonomic keys and descriptions do not exist. It is intended to upgrade (where necessary) the working keys and descriptions of voucher species currently being used in several laboratories, and make these available, as an aid in identification, to people working on macrobenthic communities. This will provide a consistent identification and naming system to be used in various ecological studies etc., so that the body of distrubutional, biological, and ecological information, gathered by such studies on particular species, will all be available when taxonomic descriptions are finally carried out.

Initially it is intended to concentrate on Victorian fauna, and to distribute the various circulars to a limited number of individuals in Victorian institutions. Depending on support given to the scheme, and the availability of people willing to supply information or to act as group co-ordinators, it may be possible to extend the system to cover other areas of Australia. The ultimate aim is a series of handbooks for identification of Victorian/Australian aquatic macroinvertebrates. Continual feedback between users and co-ordinators is essential for the system to provide maximum value.

Groups to be included in the scheme initially have been chosen on the basis of their importance in stream communities, the lack of existing identification aids, and the existence of someone willing to work them up within this system. In groups so far selected and listed below, only nymphs or larvae will be included in the system.. Anyone wishing to take part in this scheme, or who feels they may have something to contribute on particular groups should contact the relevant group co-ordinator listed below. The people listed also constitute an informal committee overseeing the scheme. Enquiries, suggestions on inclusion of other groups, offers to act as co-ordinators etc., should also be addressed to one or other of these people.

Odonata - Peter Nuttal, Biologist,
Dandenong Valley Authority,
208 Princes Highway,
DANDENONG, 3175.

Leptophlelciidae - John Dean, Biologist,
M.M.B.W. Laboratories,
P.O. Box 4342,
MELBOURNE 3001.

Other Ephemeroptera - Ian Campbell,
Center for Water Studies,
Caulfield Institute of Technology,
P.O. Box 197,
CAULFIELD EAST 3145.

Elimidae - John Blyth, Biological Survey Department,
National Museum of Victoria,
71 Victoria Crescent,
ABBOTSFORD 3067.

Chironomidae - Bruce Chessman, Biologist,
La Trobe Valley Water and Sewerage Board,
P.O. Box 348,
TRARALGON 3844
and John Blyth.

Tipulidae - John Blyth.

Other Diptera - Geoff Duke, Roger Gaymer,
Department of Environmental Studies,
Rusden State College,
662 Blackburn Road,
CLAYTON 3168.

Free Living Trichoptera - (Hydrobiosidae, Hydropsychidae, Philopotamidae, Polyoentropodidae, Stenosychidae, Ecnomidae)
John Dean

Other Trichoptera - Roger Gaymer and Geoff Duke.

Biological Monitoring Working Group

A biological monitoring working group comprising representative biologists from the State Rivers and Water Supply Commission of Victoria, the Albury Wodonga Development Corporation of New South Wales and the Engineering and Water Supply Department of South Australia are currently developing, under direction from the River Murray Commission, a programme of biological monitoring using aquatic macroinvertebrates for the River Murray and its two major tributaries in south-eastern Australia. The programme, now 12 months advanced, is designed to operate in two distinct phases with the principal aim being to:-

> *Systematically sample and record the aquatic macroinvertebrate populations of the rivers in such a way as to provide a substantial long-term biological record to complement the physical and chemical data already being collected, and so provide an additional aid in detecting and interpreting changes in water quality and river health.*

A two year 'Establishment Phase' will initially allow the development of a suitable field, laboratory and analytical methodology to achieve the principal aim described above. This will be followed by a 'Monitoring Phase' which will operate over many years in conjunction with, and as a complement to, the water quality monitoring programme.

The programme utilises 14 biological monitoring stations located at or near the water quality monitoring sites which cover a longitudinal distance of approximately 2,260 km. The total length of the River Murray is estimated to be 2,530 km. Sampling is undertaken four times per year and is based on a seasonal pattern.

An artificial substrate sampling technique utilising a 6 week exposure period has been adopted as the principal method: a faunal collection augmented by hand sweep-net samples. The artificial substrate samples (ASS) used in the study has been specially designed to suit the peculiar conditions of the River Murray and its tributaries. Comparative studies of other biological sampling techniques (i.e. grab and airlift devices) are currently being undertaken.

Detailed measurements of invertebrates biomass and substrate composition are also being collected to assess their long-term value as indicators of river health.

Officers involved in the project include G. Bennison (SR&WSC): T. Hillman (AWDC): P. Waller (E&WS) and N. MacKay (RMC). Phase 1 of the study will be complete by October 1982.

Have you lost a watch?

Did you loose a watch at the Narooma Conference last May? A watch was left on the dais by one of the Sunday speakers. An announcement at the barn dance that evening failed to locate the owner - perhaps he had already left Narooma. If you think that you are the owner of this watch please contact Frank Burns, 22 Fiander Avenue, Glen Waverley, Vic 3151 ('phone (03)232 4281).

1981 CONFERENCE

A BIOLOGICAL INTERPRETATION OF PHYTOPLANKTON PHOTOSYNTHETIC PRODUCTION AS A FUNCTION OF LIGHT ABSORBANCE

Rod Oliver, Botany Department, University of Adelaide

The aim of the many mathematical models relating phytoplankton photosynthesis to light intensity (P-I curves) is to provide descriptive parameters useful for comparing photosynthetic responses over time and space. Two typical parameters obtained from P-I curves are α the initial slope and I_k the light intensity indicating the onset of light saturation. These parameters have been used as indicators of the physiological condition of phytoplankton populations. The assumption underlying such comparisons is that the potential absorption per unit phytoplankton biomass is constant. In this paper data from Mt. Bold Reservoir, South Australia is used to ascertain the implications of variations in light absorbance on both photosynthetic parameters and integral photosynthesis. It is shown that light absorption per unit phytoplankton chlorophyll α varies over a threefold range and is dependent on both biological and environmental factors. As a result photosynthetic parameters obtained from P-I curves are partially dependent on environmental factors and consequently are not suitable indicators of the physiological condition of phytoplankton.

Empirical models of integral photosynthesis are derived from P-I curves and so contain compound variables such as α and I_k, making biological interpretation difficult. A model is developed which considers the two basic steps in the photosynthetic process, the absorption of light and the utilization of the absorbed light. This model is successfully applied to data from Mt. Bold Reservoir. The model is further used to attribute variations in integral photosynthesis to underlying mechanisms. Comparisons of data from different lakes illustrates the value of the model in assessing the relative photosynthetic productivity of the phytoplankton populations.

ASPECTS OF THE PHOTOSYNTHETIC PRODUCTION OF BENTHIC MICROORGANISMS IN A N.S.W. ESTUARY

Max Giles, Environmental Science Division, AAEC.

Models of the productivity of benthic microorganisms under variable light conditions (PvI curves) which have been constructed from laboratory experiments and checked by in situ readings are presented. The most realistic approximation had the form

$$P = \frac{m\alpha I}{\alpha^2 + m^2 I^2}$$

where α and m roughly correspond to the saturated rate and the initial slope of the curve respectively.

Three sediment types from the intertidal and immediate subtidal flats

were studied and the annual inorganic carbon input due to photosynthetic activity was derived by in situ methods and by calculation from the laboratory constructed models using real-time light intensity data. Results obtained by the latter method gave values varying between 47 and 113 grams carbon per square metre per year for the three sediment types.

Investigations done during the course of the study to clarify certain unknowns showed that dissolved inorganic carbon levels in interstitial sediment water were significantly higher than water column concentrations. This would have the effect of increasing the values above. It was also found that there was a significant biologically operated uptake of dissolved inorganic carbon in 'dark' incubations at two of the sampling sites.

Oxygen input into the upper 3 mm layer of the sediment due to the photosynthetic activity described was considered to be important in maintaining the equilibria which exist in this chemically-active region.

BLUE-GREEN ALGAE: ENIGMATIC OR PREDICTABLE?

T.D. Box, Department of Botany, University of Sydney

Planktonic blue-green (cyanobacteria) are associated with nutrient-rich water-bodies and occur during the summer and early autumn in temperate climates when ambient nutrient levels are lowest. This has been called one of the 'paradoxes of the plankton'.

Observations have been made on a population of Microcystis aeruginosa Kütz.emend.Elenkin over a period of 20 months at Carcoar Dam, N.S.W. (300 km west of Sydney). This is a 37×10^6 m^3 impoundment operated by the Water Resources Commission for the control of downstream irrigation on the Belubula, a tributary of the Lachlan.

Growth rates of seven unialgal Microcystis isolates from N.S.W. and Victoria ranged from 0.73 - 0.93 div. day^{-1}, which compared with 0.57 and 0.58 div. day^{-1} for two English strains. The growth rate of a strain (B1) from Carcoar Dam was observed to increase from 0.5 div. day^{-1} to 0.8-0.9 div. day^{-1} over a period of 20 months after isolation to unialgal culture. This may explain differences observed between in vitro and in vivo growth rates. Laboratory experiments showed that the growth rate for the B1 strain was maximal over the pH range 7-9, at light intensities greater than 30 $\mu E\ m^{-2}\ s^{-1}$, and increased in a linear fashion with temperature from zero growth at 10°C to 0.9 div. day^{-1} at 35°C (temperatures >35°C were not investigated).

The occurrence of the lake population of Microcystis was not related to changes in the pH of the lake water, which lay between 8 and 9, but was related to the onset of thermal stratification. Examination of the lake data showed that the epilimnetic populations occurred at temperatures of c. 20°C and were absent when the temperature fell below 10°C - this occurred two months after overturn. The appearance of the alga in the epilimnion followed the increase in the temperature at the lake bottom from 10°C to 15°C. It is known that Microcystis overwinters on the bottom sediments and it is suggested that temperature may be a factor controlling the development and growth of populations of Microcystis. This may allow a degree of prediction to be applied to the development of Microcystis populations. The 'paradox of the plankton' may be

a result of this temperature-dependent growth.

SALT LAKE MICROBIAL MATS - A PROSPECTUS

John Bauld, Baas Becking Geobiological Laboratory, Canberra.

Communities of microorganisms which colonize sediments and produce cohesive, prostrate, macroscopic structures are known as microbial mats. They occur in both permanent and ephemeral bodies of saline water, including coastal lagoons and salina systems. The photosynthetic character of the dominant microorganisms is indicated by the loosely interchangeable descriptive terms "algal mat" and "cyanobacterial (blue-green algal) mat". The majority of microbial mats are constructed primarily by cyanobacteria but eucaryotic algae such as diatoms and chlorophytes, and photosynthetic bacteria, may be important components. Filamentous cyanobacteria are generally the dominant microorganisms. They produce a cohesive organic fabric which promotes sediment trapping and accumulation by virtue of their filamentous nature, gliding motility, and mucilaginous sheaths. The establishment of a mat profoundly affects the physicochemical properties of the sediment. Decreased permeability to fluid and gas exchange promotes steep gradients of dissolved oxygen, dissolved sulfide and redox potential. Together with light intensity these gradients result in a compact stratification of physiologically distinctive microbial populations and photosynthetic pigments. The littoral habitat of most microbial mats exposes them to considerable diurnal and seasonal variations of salinity, temperature and light intensity often resulting in evaporation and/or desiccation. The response of mat components to these stresses will be examined using examples from Solar Lake (published data of Cohen and others), Australian salt lakes, and the high intertidal environment in arid and semi-arid areas. Intact Spencer Gulf mats are summer light-saturated at ca 1000 $\mu E\ m^{-2}s^{-1}$ with no inhibition at 2000 $\mu E\ m^{-2}\ s^{-1}$. These high values probably result from avoidance reactions due to gliding motility. Broad salinity optima for photosynthetic $^{14}CO_2$ fixation are observed in these mats. Recovery from desiccation commences immediately on rewetting and appears to be complete after about 2 hours. Primary production in these mats has been estimated to be up to 3 g C $m^{-2}d^{-1}$. The relatively low species diversity and high population densities attained make these communities attractive for ecosystems analysis, particularly in salina systems, where some measure of environmental control may be obtained.

PREDICTION OF CHANGES IN ATTENUATION OF PHOTOSYNTHETICALLY AVAILABLE RADIATION (PAR) LIKELY TO RESULT FROM CHANGES IN OPTICAL WATER QUALITY

John T.O. Kirk, CSIRO, Division of Plant Industry, P.O. Box 1600, Canberra City, A.C.T. 2601.

The turbidity and colour of the water in river, lakes and estuaries can be drastically modified by the activities of man, such as clearing of forest, changes in agricultural practice, establishment of major water-using properties - absorption and scattering coefficients, volume scattering function - will affect the penetration of sunlight into the water, and therefore alter the amount of primary production which takes place and also influence the type of phytoplankton or macrophytes which dominate. In order to devise management strategies for our aquatic ecosystems, and in particular, to predict the consequences for those ecosystems of changes in land use in the catchments, we

need methods of predicting the effects of such changes on penetration of PAR.

A method has been developed, using the Monte Carlo calculation procedure, by means of which, given the inherent optical properties of a natural water, the penetration of sunlight into the water body can be predicted. Values of vertical attentuation coefficient for PAR, calculated by this means for four lakes in the southern tablelands of N.S.W./A.C.T. were in good agreement with those measured in situ with a quanta meter.

What is now needed, if the full potential of this predictive modelling procedure is to be realized, is more information on the effects that specific types of land and water use have on the optical properties of surface water.

CREEKS IN THE WESTERNPORT CATCHMENT

Roger Gaymer, Environmental Studies Department, Rusden State College.

Early in 1980 the Victorian Ministry for Conservation approached the Environmental Studies Department of Rusden College of Advanced Education offering a contract to study the beneficial uses and characteristics of representative waterways in the Westernport catchment.

The agreed task specification included a description of the fauna, water quality and other parameters of the creeks, and to this end 39 sites on 6 creeks around the bay were sampled monthly for a 15 month period from April 1980 to July 1981.

The creeks studied range from highly modified urban and agricultural systems to relatively undisturbed forested catchments. Preliminary results indicate varied faunal communities and water quality. A computer analysis will be attempted, with the aim of defining faunal associations and correlations with water quality and land use parameters.

The extensive animal collection will be integrated with the fresh water invertebrate voucher system currently being organised by the Victorian Chapter of the A.S.L.

POTAMOPLANKTON OF THE LOWER MURRAY RIVER.

Russell Shiel, Department of Zoology, University of Adelaide.

Differences in the plankton composition of the River Murray and its major tributary, the Darling River, relate to the extent of impoundment. The Murray has been successively regulated; the Darling is relatively unimpounded. Seasonal fluctuations in plankton composition in the lower Murray (below the Darling confluence) reflect the disproportionate contributions from the two rivers. Characteristically, Murray flows carry blooms of blue-green algae (Anabaena/Anacystis) in summer, and diatoms (Melosira/Cyclotella) in winter and spring. The zooplankton, predominantly microcrustacea, is that of upstream reservoirs. Darling flows typically have high abiogenic turbidity, low algal biomass, and a zooplankton dominated by warm stenothermal pantropical rotifers. Of 133 zooplankton taxa recorded 1976-80 from the lower Murray, more than half were pseudoplanktonic or littoral incursions. Of the dominant potamoplankters,

approximately half were indigenous. Plankton density and diversity were markedly contagious across the river and longitudinally, and increased downstream. Mean zooplankton density at Mannum S.A. was 119 ℓ^{-1}. average community composition was 14.4 rotifers, 6.0 cladocerans and 2.4 copepods. Changes in temperature, salinity and turbidity significantly influenced some of the predominant taxa. Most common zooplankters were eurytopic. Cosmopolitan forms, particularly Rotifera, are regarded elsewhere as indicators of eutrophy.

THE EMERGENCE OF SOME TEMPORARY POND INVERTEBRATES FROM DRIED MUD AFTER FLOODING

Maryanne E. McKaige, Water Studies Centre, Caulfield Institute of Technology.

In an experimental investigation of the emergence of temporary pond invertebrates from dried mud, mud core samples taken at different profile levels from a dried pond basin were flooded and maintained at 3 temperature regimes: 10°C constant, between 10° and 18°C fluctuating and 18°C constant. Emergence was greatest from cores taken at the lower profile levels and kept constantly at 18°C.

In a separate experiment, adult Coleoptera, Hemiptera, the amphipod Austrochiltonia australis, Cyclopoida and Harpacticoida were found to have emerged from dried pond mud within 4 days of flooding. The emergence of Coleopterans was surprising, since the view is generally held that Coleoptera disperse in response to the drying up of the aquatic habitat.

Dispersal was shown experimentally to be related to the degree of desiccation to which the pond mud was subjected, rather than just the absence of free water. Desiccation of pond mud destroyed the cyclopoids, harpacticoids and Austrochiltonia australis, but had a less significant effect on the emergence of Cladocera, Calanoida, Ostracoda, Hydracarina, Gastropoda and the notostracan Lepidurus apus viridis.

THE HISTORY OF 4 MAAR LAKES IN CENTRAL VICTORIA FOR THE LAST 10,000 YEARS

Patrick De Deckker, Biogeography and Geomorphology, ANU.

Fossil ostracods have been extracted from closely spaced samples from cores taken from 4 maar lakes (Bullenmerri, Gnotuk, Keilambete and Purrumbete) in Central Victoria. These lakes, being small internal drainage basins, are ideal "water budget recorders" as water levels reflect local precipitation and evaporation (ground water influence is thought to be minimal).

Ostracods are minute (0.5 - 3 mm) crustaceans which have a calcareous shell and can be easily preserved as fossils. As various species are restricted to particular salinities and/or other water quality parameters, the recovery of their fossil shells can be used to reconstruct changes in water salinity and, consequently, water levels for the lakes. When available, other fossil evidence (e.g. cladoceran and fish remains, gastropods, non marine forams, sponge spicules etc.) was used to trace palaeosalinities.

The results indicate that the level of Lake Purrumbete did not fluctuate much during the last 6,000 years whereas, for the other 3 lakes, it fluctuated

drastically, and nearly always synchroneously, for the last 10,000 years.

Past climates are then inferred from the water level curves for the lakes.

ZOOPLANKTON COMMUNITIES IN FARM DAMS IN THE ADELAIDE HILLS

Michael Geddes, Department of Zoology, University of Adelaide.

The zooplankton communities in four farm dams were investigated. Different zooplankters occurred in the various dams and the zooplankton community changed seasonally. These differences did not seem to be attributable to physico-chemical conditions but to processes of competition and predation within the zooplankton. In the dam with Perca fluviatilis, fish predation excluded large zooplankters and Bosmina, Tropocyclops and Ceriodaphnia dominated. In fishless dams large zooplankters, Boeckella and Daphnia, dominated in winter and spring. In summer these species were eliminated or decimated presumably by the predator Anisops. Further experimental work on the structuring of zooplankton communities by biotic interactions is needed.

THE ECOLOGY OF FRESHWATER MUSSELS IN THE RIVER MURRAY

K.F. Walker, Department of Zoology, University of Adelaide.

Two freshwater mussels, Alathyria jacksoni and Velesunio ambiguus, are associated with the River Murray. A. jacksoni is a river species, found in moderate to strong currents but not in floodplain habitats. V. ambiguus is a floodplain species, found in small streams, lakes, billabongs and river impoundments. Impoundment of the Murray, particularly in South Australia, has extended the range of the floodplain species. Both species are variable in size and shape, but in A. jacksoni there is a dual growth pattern, adaptive for moderate or strong currents. The largest V. ambiguus [10 cm length] are about 12 years old, and the largest A. jacksoni [15 cm] about 30 years old. Some A. jacksoni populations have bimodal length frequency distrubtions due to low recruitment in the drought years 1967-1968. The two species differ markedly in tolerance to drought and low oxygen, but not salinity and temperature. Their life histories are essentially similar. There are complementary river and floodplain species among the other animals and plants, demonstrating the integrity of these environments as parts of the Murray ecosystem. [see Australian Water Resources Council Technical Paper, in press].

PASSING TIME WITH STONEFLIES

Cathy Yule, Department of Zoology, Monash University.

Stonefly nymphs are typically found in cool, permanent flowing waters. Species of stonefly in the genus Dinotoperla are found in a wide variety of habitats throughout Victoria. These habitats range from cool, permanent upland creeks to lowland pools which dry up in summer.

In this study a comparison has been made of the life histories of six species of Dinotoperla in the various habitats. The length, timing and rigidity of their life cycles is related to the predictability of their environment

in terms of water temperature and flow rate.

Dinotoperla arenaria is found mostly in cool, permanent creeks. It has a rigid life cycle lasting about one year. The eggs hatch in winter, very soon after they are laid.

D. christinae is very similar to D. arenaria in distribution and life history. It has a shorter life cycle however, with the nymphs emerging in spring about 4 months after they are laid.

D. brevipennis is present in creeks which stop flowing in summer. It is able to cope with this environment, unlike D. arenaria and D. christinae because it grows through winter and has a summer diapause. It also has a rigid life cycle.

D. fontana is found in habitats ranging from permanent mountain creeks to lowland creeks which stop flowing in summer. It has a very flexible life cycle. In some creeks the populations appear to have synchronous hatching and emergence while in others hatching and emergence occurs throughout most of the year.

D. serricauda is found in flowing waters ranging from temporary grassy drains to very cold mountain creeks. They have a flexible life cycle with hatching and emergence occurring throughout most of the year.

D. banae is only found in temporary habitats (mostly pools). Nymphs hatch a few days after the first heavy winter rains. They grow very rapidly, emerging 3 or 4 months later in spring before water temperatures get too high. The eggs remain dormant in the mud at the base of the pools for 8-10 months until the following winter.

STREAM COLONIZATION IN SRI LANKA

John Benzie, Population Biology, Australian National University

Inputs from aerial, deeper sediment, upstream and downstream sources of invetrebrates to bare areas of sand were investigated. All were found to provide significant inputs to the sytem. The communities developing on the bare areas reached equilibrium in three to four weeks and did not show any succession, their structure resembling that of surrounding benthos. Traps, entry to which was restricted to a single source, were only colonised by a subsection of the community but the proportions of the separate groups within these did not differ from the proportions within the controls. To this extent colonisation within sections of the community was random. Total numbers colonising the restricted entry were not significantly different from the control, suggesting these subgroups in no way contribute only a specific proportion of individuals to a site.

ALTERNATIVE APPROACH TO BIOLOGICAL MONITORING: SAMPLING STREAM DRIFT

A.H. Arthington and D.L. Conrick, School of Australian Environmental Studies, Griffith University, Nathan, Queensland, 4111.

Abstract

The species richness and abundance of drifting benthic invertebrates decrease dramatically downstream of the outfall from the Mimosa Sewage Treatment Plant into Bulimba Creek, Brisbane. Residual chlorine from the disinfection of sewage, dissolved metals and dissolved oxygen deficiency appear to impair or eliminate most of the drift fauna. Psychodid larvae and pupae dominate the drift downstream of the outfall; they breed in the effluent at the point of discharge and their abundance indicated severe organic enrichment of creek water by sewage wastes. Sampling benthic invertebrates while drifting may be a relatively cheap and easy approach to biological monitoring in lotic systems.

SIZE SELECTIVE PREDATION OF *Daphnia* BY THE BACKSWIMMER *Anisops deanei*

John Reynolds, Department of Zoology, University of Adelaide.

Laboratory studies of notonectid predation on four arbitrary size classes of Daphnia presented over a range of prey densities showed adult Anisops deanei to have a strong preference for Daphnia smaller than 2 mm, although physically capable of capturing Daphnia of all sizes. Predation over a 24 hour period was restricted to the hours of darkness. Cephalic crests were induced in laboratory Daphnia within a fortnight by the presence of A. deanei. However, individual crested Daphnia from these crested populations of the preferred size range (less than 2 mm) were no less vulnerable to predation by A. deanei.

VICTORIAN RESERVOIR WATER QUALITY PROBLEMS CORRECTED BY ARTIFICIAL DESTRATIFICATION DURING 1980/81 SUMMER

Frank L. Burns, Consulting Engineer, 22 Fiander Ave., Glen Waverley, 3150.

In recent years it has become increasingly apparent that many of the water quality problems experienced in reservoirs originate from the normal summer stratification behaviour. The warm upper layers tend to isolate the colder lower layers from access to atmospheric oxygen, so that the normal biological oxygen demand is not met, and anoxic conditions develop, giving rise to:

- unpleasant tastes and odours
- increased dissolved iron and manganese, leading to bacterial slime growth and increased friction coefficient in pipelines
- increased corrosivity
- fish kills
- increased nutrient uptake from the bottom muds leading to algal problems.

Economical methods of correcting these problems by artificial destratification have been developed, and the following three case studies of applicat-

ions of these techniques in Victoria during the 1980/81 summer will be presented.

1. Bullarto Reservoir

A 160 ML capacity, 10 M deep town supply storage for Daylesford, where operation of a 100 CFM compressor for 2½ days corrected an acute taste and odour problem.

2. Little Bass Reservoir

A 240 ML capacity 10 M deep town supply storage for Poowong, where operation of a 100 CFM compressor for 6 days corrected a taste and odour, and algal problem.

3. Eppalock Reservoir

A 300,000 ML capacity, 38 M deep storage from which supply water is pumped to Bendigo through a 26 km long, 750 mm diameter pipeline. Intermittent operation of a 350 CFM compressor throughout the summer prevented the normal development of anoxic conditions, and excessive increase in dissolved iron and manganese, which had given slime growth and friction loss problems in the supply pipeline in previous years.

PHYSIO-CHEMICAL CHARACTERISTICS OF LAKE MOONDARRA AND ITS SOURCE WATERS

A. McCredie, Mount Isa Mines Ltd.

Lake Moondarra is a water supply and recreation impoundment situated in arid, tropical north-west Queensland.

The lake in its thermal stratification characteristics is essentially cheimomictic (sensu Bayly and Williams), although the intense summer rainfall creates turbulent mixing in the more shallow southern part of the lake where the greater part of the inflow into the lake occurs.

D.O., Redox, pH and conductivity have been measured in the water column.

Primary productivity in the lake is very high, but the nutrients particularly phosphates and dissolved organic carbon are moderately low, probably due to the very rapid cycling of nutrients under tropical conditions.

The major ionic composition of the lake and source waters differs markedly from typical freshwaters, sodium, chloride and sulphate predominating, and calcium and bicarbonate being depauperate. After several years without overflow, the lake waters have a lower percentage of calcium and magnesium than the source waters, suggesting the existence of significant mechanisms for removing Ca and Mg from the lake waters.

The pH levels can rise above 8.5 before the summer rains, but drop to about 7 after the rains. This phenomenon is associated with phytoplankton productivity.

THERMAL AND CHEMICAL STRATIFICATION IN A NEAR MEROMICTIC PERCHED LAKE ON FRASER ISLAND AND ASSOCIATED SEDIMENTARY PROCESSES

Dr. Maureen E. Longmore, A.N.U., Mr. B.M. O'Leary, Q.I.T., Professor C.W. Rose, Griffith University.

Monitoring of a perched, brown-water acid lake on Fraser Island has been carried out periodically over the last four years. The lake is 8 to 9 metres deep, ca 9 hectares in area with a small, steep sided catchment dominated by dry to wet sclerophyll forest on deeply weathered siliceous sand. The main sedimentary component in the lake is allochthonous organic material. The secchi disc reading ranges from 80-150 cm due to extinction of light by the dissolved organic acids.

Measurement of vertical temperature and dissolved oxygen profiles reveal long periods of persistent thermal and chemical stratification which suggest the lake may be meromictic. In the hypolimnion conductivity falls, pH rises, sulphide levels rise and higher concentrations of total phosphorous and iron have been observed above the sediment surface, when the lake is thermally stratified. Synchronous measurements of sedimentation reveal pulses of sedimentation during the apparently brief period of turnover in mid-winter. Anoxic conditions quickly return to the hypolimnion. During summer periods sedimentation rates in the epilmnion are frequently higher than the hypolimnion.

In the sediment, vertical profiles of caesium-137 (^{137}Cs) show an exponential increase towards the sediment surface. This pattern bears no resemblance to the temporal variation of ^{137}Cs fallout in Australia, which peaks in 1964 and 1971 and decreases in recent years to just detectable levels. It is hypothesised that sediment/water exchange processes under anoxic conditions, along with biological concentration, are causing the ^{137}Cs to become concentrated at the sediment surface. It is believed that the sediment is not acting as a sink for this radioactive element, but is continuously releasing it into the lake ecosystem. Total phosphorus shows a very similar profile in the surface sediments.

The low nutrient, low oxygen status of these waters will no doubt have an effect on the organisms that can survive in the lake. This is currently being investigated through limnological/palaeolimnological studies. Interpretation of palaeolimnological data must take possible sediment/water exchange processes, operating today and in the past, into consideration. This emphasises the need for co-operation between modern limnologists and palaeolimnologists in order to provide reliable historical ecological information on the development of the lake and its catchment.

PALAEOECOLOGY AS A TOOL IN MODERN DIATOM ECOLOGY

J.L. Richardson

Palaeolimnologists who study fossil diatoms of the past few millenia usually are extremely interested in the ecology of modern diatoms. If the ecological contexts of modern diatom associations are known, the task of interpreting fossil assemblages becomes simpler and surer, because close analogues of the modern associations (often containing the same species as today) often appear in the fossil sequences. The present thus can be used as a key

to the past. But is it possible to reverse this process and use the past as a key to the present, once a lake's diatom history has been delineated? What, if any, use is a fossil diatom stratigraphy to the student of modern diatoms?

The following suggestions are advanced:

(1) In a fossil sequence species complexes or characteristic associations often are very easy to identify due to their persistence over considerable spans of time or to their recurrence, after intervals of absence, as assemblages identical to associations elsewhere in the sequence.

(2) If, from modern studies, specific ecological parameters are known for a species occurring in a fossil sequence, suggestions can be made about the requirements of other species that behave like it - or perhaps very unlike it - in the fossil sequence. For example, in a core from Lake Naivaska, Kenya, several characteristic associates of Stephanodiscus astraea, a diatom common today only in low silica waters, can also be postulated as low-silica species, whereas Synedra, a genus whose stratigraphic pattern is opposite that of S. astraea, can be suggested as a possible high-silica taxon. The fossil sequence thus encourages experiments involving the culture of specific diatom taxa to verify or contradict these suggestions.

(3) Stratigraphies of the recent past taken by the freeze-coring technique have been shown, for at least some lakes, to faithfully record the short-term (e.g. seasonal) dynamics of past diatom populations. Fine-interval study of frozen cores taken through the mud-water interface is an excellent way to reconstruct and monitor processes such as cultural eutrophication of a lake.

Fossil and modern diatom studies thus complement and inform each other in mutually valuable ways. This is only to be expected of organisms which are both ecologically sensitive and, in many cases, excellently preserved as fossils.

THE MANAGEMENT OF WETLANDS

David Mitchell and Jane Roberts

Wetlands are difficult to define with precision but are generally recognised as areas characterised by shallow water and the presence of aquatic macrophytes.

Wetlands may act as sponges, absorbing water at times of high flow and releasing it slowly at times in low flow. They also act as sinks for a large variety of material that is deposited in them by water draining off their catchments. In this way, they function as natural "filter" systems. Amongst the deposited material are plant nutrients but, in this case, wetlands may additionally act as sources of nutrients for outflowing waters and also cycle nutrients between their components as well as release nitrogen through denitrification. Wetlands are an important feeding ground and habitat for specialised animals, particularly waterfowl.

The value of wetlands, either as a resource for human communities, or as a means of maintaining ecological stability, is not known and is certainly little appreciated in Australia. For this reason, wetlands are often neglected, frequently "reclaimed", and generally mismanaged.

As a consequence of this situation, there is little awareness of the need to manage wetlands and even less knowledge of how to do so. There are four wetland systems which are considered to be particularly important in terms of their management and which need to be better understood.

(i) The rate of change within systems can be very variable. Systems range from ephemeral systems present in years of high rainfall, annual seasonal systems, permanent systems with relatively short-term cyclic changes, to permanent systems in which there is little apparent change.

(ii) Wetlands exist because of the presence of water and of specialised plants adapted to grow in these conditions. Management must thus be related primarily to water balance and quality, using the plants as a monitor of system welfare, rather than animals that may be using the system as a habitat. This requires good understanding of appropriate hydrology and aquatic plant ecology.

(iii) Water level fluctuations are very important and are characteristic of Australian wetlands.

(iv) Even though there is considerable cycling of substances within them, wetlands may be more dependent for their long-term existence on allochtonous sources for nutrients, water, and possibly other factors, than has hitherto been appreciated.

Sound management of wetlands in Australia requires that more knowledge and clearer understanding of these systems be obtained and that society and its decision-makers become more aware of the value of wetlands. Clear objectives should be set and expressed in terms of reasonable and attainable goals. Limnologists have the skills and the responsibility to promote this process in the interest of Australian water resource management.

ABSTRACTS OF THESES

This is the second of a series of abstracts of recent limnology theses from Australian universities. Theses from the Department of Zoology, University of Tasmania were abstracted in Vol. 18, Part 2 of the Newsletter.

The abstracts presented here are from the Department of Zoology, University of Adelaide. Please note that the Honours theses are not usually available for loan but may be consulted in the Department (the University of Tasmania Zoology Honours theses are available for inter-loan through the library system).

THE RESPONSE OF TWO FRESHWATER MUSSEL SPECIES TO CHANGING ENVIRONMENTAL SALINITY

A.H. Vickery, B.A. Honours Thesis, 1978

Supervisor: Dr. K.F. Walker

The response of two freshwater mussel species, Velesunio ambiguus and Alathyria jacksoni, to increasing environmental salinity was investigated.

In the major experiment, mussels of both species (wedged open) were exposed to experimental solutions of 1,2,3,4 and 5 ppt. (plus natural and artificial freshwater controls), at two temperatures (15 and 25°C), for 36 hours. The change in weight (over the experimental period) and heart rate were recorded, and the osmotic pressures and sodium concentrations of blood samples determined.

The results indicate no difference between the two species regarding osmoregulatory ability. Environmental salinity does have an effect; as it increases, osmoregulation is replaced by osmoconforming behaviour. Temperature has minimal effect on osmoregulation in the two species.

As an extension of this work, an attempt was made to determine the lethal salinity of wedged and unwedged Velesunio ambiguus. The results are inconclusive, but indicate that unwedged mussels are less vulnerable to osmotic stress than mussels wedged open. Weight regulation was also regained by wedged specimens after a considerable period (approx. 20 days).

The environmental salinity required to stimulate shell closure was also investigated. Oxygen consumption of Velesunio ambiguus was monitored in various salinities (1, 3 and 5 ppt.) at 15 and 25°C, and unwedged mussels were exposed to similar media for 36 hours and the osmotic pressure of blood and mantle-cavity fluid samples determined.

Interpretation of the oxygen consumption data proves difficult, but when considered with the data relating to the unwedged mussels, it appears that valve closure occurs at salinities of approximately 3 ppt. (slightly greater salinities are required at 25°C cf. 15°C).

OSMOREGULATION AND RESPIRATION IN THE FRESHWATER CRAYFISH *Euastacus armatus* (VON MARTENS) AND *Cherax destructor* CLARK

R.J. Kaines, B.Sc. Honours Thesis, 1979

Supervisor: Dr. K.F. Walker

The hypothesis that rising salinities in the River Murray have excluded Eustacus armatus from South Australia was tested. A comparative ecophysiological study with Cherax destructor assessed adaptations to increased salinities using indices of osmoregulation and respiration. New methods of haemolymph and urine collection were developed. An unknown factor in tapwater, possibly of River Murray origin, affected laboratory animals by stimulating the sodium uptake mechanism to produce markedly hyperosmotic haemolymph at all salinities. Euastacus was particularly susceptible, and probably adversely affected by high internal body fluid concentrations.

POPULATION REGULATION OF WATER MITES (UNIONICOLIDAE) PARASITIC ON THE FRESHWATER MUSSEL, *Velesunio ambiguus* (PHILLIPI), IN LAKE ALEXANDRINA, SOUTH AUSTRALIA

L.C. Gavey, B.Sc. Honours Thesis, 1979

Supervisor: Dr. K.F. Walker

Two approaches are taken to the present study: one from ecological modelling and the second following a report of congeneric mites being limited by territoriality. The dispersion models are demonstrated to be inadequate indicators of the determinants of a population's distribution patterns, but the modelling theory of both host and parasite populations being regulated by parasite-induced host mortality cannot be discounted. However, a limit to parasite abundance within hosts may occur in several species, to the exclusion of regulation by parasitism.

Effectiveness of experiments was restricted by insufficient knowledge of the life histories of the mites. It is suggested that further work concentrate upon detailing life history characteristics such as egg-laying activity and relationships with other organisms, but particularly the derivation of nutrition and the parasitism of young mussels. Such information can provide a basis for the determination of the regulatory mechanism of Unionicola.

THE ECOLOGY OF *Lepsiella vinosa* (MOLLUSCA; GASTROPODA) WITH PARTICULAR REGARD TO ITS FEEDING BEHAVIOUR

D.E. Bayliss, Ph.D. Thesis, 1979

Supervisor: Dr. A.J. Butler

Lepsiella vinosa is a muricid gastropod which is found in South Australian mangroves where it eats two species of barnacles, Balanus amphitrite and Elminius modestus, which are attached to the pneumatophores and branches of the mangrove Avicennia marina.

The distribution of pneumatophores is heterogeneous and distinct prey patches are formed. A series of these patches were surveyed to determine the impact of L. vinosa predation on the barnacle populations and the influence of barnacle density on prey selection by the predator.

B. amphitrite settles between Spring and mid-summer. It is subject to fluctuations in reproductive success and "failures" were recorded in 1975 and 1976. L. vinosa eliminated 9.3% to 30.8% of the heavy 1974 Spring settlement in one year. After three years only those B. amphitrite which settled in refuges survived. L. vinosa could potentially eliminate all B. amphitrite in the patches between successive breeding seasons.

E. modestus can settle continuously and unlike B. amphitrite its numbers recover quickly after a "catastrophe". In crowded situations it is crushed by B. amphitrite. Frequent restocking of the patches prevent its elimination by L. vinosa predation.

Prey selection by L. vinosa is influenced by both relative and absolute densities of the barnacle species. At moderate densities less than 25 barnacles/metre pneumatophore, the predator fed proportionally; L. vinosa feeding on the less abundant species changed to the more abundant species as its relative density increased. At high densities, 50 to 70 barnacles/metre pneumatophore, E. modestus was progressively dropped from the diet as the absolute density increased.

Laboratory experiments indicate that L. vinosa can be trained to either barnacle species and shows switching in terms of Murdoch's (1969) model. Field cage experiments indicate that L. vinosa shows switching provided that the absolute density of B. amphitrite is not too high. The switch tends to become stronger over an eight week period.

In both the laboratory and field experiments L. vinosa had a weak preference for B. amphitrite, $c = 1.26$, when equal numbers of each species were present. The preference appears to be consistent between individual L. vinosa.

In the field L. vinosa switches to B. amphitrite when it is more abundant irrespective of prior training. L. vinosa trained to E. modestus or unfed switched to E. modestus when it was more abundant. Those trained to B. amphitrite however only slowly switched to E. modestus over a period of eight weeks. A clumped prey distribution accelerated the switch.

L. vinosa also showed asymmetry in feeding rate. Those trained to E. modestus fed at the average rate irrespective of the prey presented. L. vinosa trained to B. amphitrite showed a marked reduction in their feeding rate when B. amphitrite was less abundant.

The functional response to both species appears to be type 3 and is therefore potentially stabilising. Different mechanisms are however responsible for the rapid acceleration in the number of a prey species consumed. The low consumption of E. modestus when it is rare is due to L. vinosa concentrating its attacks on B. amphitrite. Switching to E. modestus as it becomes relatively more abundant causes the rapid acceleration in the number of E. modestus consumed. The low consumption of B. amphitrite when it is rare is due to a low overall feeding rate. An increase in B. amphitrite density increases both the feeding rate and proportion of B. amphitrite in the diet causing a rapid

acceleration in the number of B. amphitrite consumed.

L. vinosa thus shows a potentially stabilising functional response which is more complex than a simple change in prey preference with relative prey density.

THE ECOLOGY OF WASTE STABILIZATION PONDS

B.D. Mitchell, Ph.D. Thesis, 1980

Supervisor: Professor W.D. Williams

Ecological interactions were studied in two waste stabilization ponds at Gumeracha, South Australia, to relate the dynamics of the major organisms present to effluent quality and, therefore, the efficiency of pond function. The roles of those organisms in algal control, the stabilization of organic material, and nutrient removal were evaluated to assess their usefulness as tools for the management of WSPs. In this manner, biological principles for pond management were evaluated.

The seasonal dynamics of the phytoplankton were related to effluent quality. Phytoplankton blooms were triggered by increasing water temperature and resulted in a significant decrease in effluent quality. Effluent concentrations of BOD, SS, TOC, and organic nitrogen exceeded influent values during phytoplankton blooms. Removal of soluble PO_4 - P and NO_3^- was highest during phytoplankton blooms. Estimated annual net production of the phytoplankton in pond 2 represented a nutrient store equivalent to over 100% of total nitrogen and total PO_4 - P retained annually. The dynamics of filamentous algae (Cladophora) and the submerged macrophyte Potamogeton ochreatus were related to phytoplankton abundance and effluent quality. Floating algal mats and submerged macrophytes inhibited the development of phtyoplankton blooms and improved effluent quality. Estimated annual net production of Cladophora in pond 1 represented a nutrient store equivalent to 47% of total PO_4 - P and 12% of total nitrogen retained in the pond annually. Annual net production of P. ochreatus represented less than 3% of total PO_4 - P and total nitrogen retained annually.

The population dynamics of the major zooplankton were related to phytoplankton abundance and effluent quality. Although temperature was the major factor determining the occurrence of zooplankton, competition and predation also appeared to be important in structuring the zooplankton community of the Gumeracha ponds. Phytoplankton blooms were terminated by zooplankton grazing. The dominant herbivore, Daphnia carinata, was a cold water form. High water temperatures increased mortality and reduced the growth rate of D. carinata and prevented it from controlling phytoplankton during the summer. The dominant zooplankter during phytoplankton blooms was the carnivore Mesocyclops leuckarti. D. carinata was a "facultative browser" and ingested the sediments during periods of low phytoplankton abundance. D. carinata and Simocephalus exspinosus were both food limited at high population densities. Total annual net production of D. carinata in pond 1 during 1977 (345 g dry weight/m^2), calculated using the population turnover-time model, was the highest yet recorded for any planktonic cladoceran. Annual net production of D. carinata determined using the population turnover-time model exceeded annual production determined using the biomass turnover model by 100%. Overestimation of daily production rate was highest during periods of high egg mortality. Total annual net

production of D. carinata (biomass turnover model) represented a nutrient store equivalent to less than 5% of total PO_4 - P and total nitrogen retained in the ponds annually.

A fish introduction experiment was conducted in enclosures within the ponds. Carassius auratus had no significant effect upon phytoplankton and zooplankton populations or on effluent quality. Growth of C. auratus increased after introduction to the pond despite decreasing water temperature. Annual net production of C. auratus was high compared to fish production in natural waters but probably represented a nutrient store equivalent to less than 2% of total PO_4 - P and total nitrogen retained in the ponds annually.

Filamentous algae and zooplankton (to a lesser degree) are useful for controlling unicellular algae in waste stabilization ponds. Harvest of unicellular algae is the most effective pathway of nutrient removal, but reasonable removal could be achieved using filamentous algae. The harvest of submerged macrophytes, zooplankton, and fish is not useful for nutrient removal.

THE DISTRIBUTION AND BIOLOGY OF AMOEBAE IN FRESHWATER IN SOUTH AUSTRALIA WITH SPECIAL REFERENCE TO THE EPIDEMIOLOGY AND CONTROL OF AMOEBIC MENINGOENCEPHALITIS

B.S. Robinson, M.Sc. Thesis, 1980

Supervisor: Dr. R.I. Sommerville

A study of the distribution of free-living amoebae in freshwater has been carried out by regular sampling of water sources and public water supplies in South Australia. Most of the genera recognized in a recent 'Illustrated Key' were identified, many of them recorded for the first time from Australia. Particular attention was given to identification of Naegleria fowleri, the amoeba responsible for thirteen fatal cases of primary amoebic meningoencephalitis in South Australia, and of nonpathogenic Naegleria species. Descriptions of two new species of Vahlkampfiid amoebae, which must be distinguished carefully from Naegleria species, are presented.

The upper limit of temperature tolerance was determined for over 400 Naegleria isolates from water samples. For Naegleria species isolated from three South Australian reservoirs, temperature tolerance correlated significantly with seasonal changes in water temperature. The distribution of 'high temperature' strains, including N. fowleri, corresponded with the seasonal and geographic distribution of the recorded infections.

A mathematical description of the influence of temperature on growth rates was derived from growth experiments with N. fowleri and N. gruberi. The seasonal changes in abundance inferred from the correlation with water temperature could be explained partly in terms of the lower limits of temperature tolerance and temperature coefficients (Q_{10}) of growth calculated from the growth equations. The influence of temperature on other physiological processes is also discussed.

Acanthamoeba species, which may cause infections of varying severity, including fatal meningoencephalitis, were also identified. Temperature tolerance of 245 isolates was relatively uniform, and no seasonal trend in their

isolation could be demonstrated.

GROWTH OF THE YABBY, *Cherax destructor* CLARKE, UNDER HIGH DENSITY CONDITIONS

P.J. Aerfeldt, B.Sc. Honours Thesis, 1980

Supervisor: Dr. M.C. Geddes

Under controlled laboratory conditions juvenile Cherax destructor in the size range, 0.080 0.500 gm, had a maximum growth rate of 0.041 gm/day and achieved 10.5 times the initial weight in a six week period. Claw clipping did not affect mean growth. Growth is superior to that of yabbies in the wild and of Macrobrachium rosenbergii under similar culture conditions. Significant growth reductions occur due to high density (263/m^2) communal holding, build up of metabolites and low feeding rate. In a static water communal system mean growth is not reduced further than in each treatment alone. This decreased growth is due to less frequent moulting and a lower weight increment per moult. Regression analyses of the weight increment per moult demonstrated that a lower limit of this equation may exist. Further decrease in growth appears to be the consequence only of less frequent moulting. Moulting frequency is the most flexible component of yabby growth.

A considerable amount of growth variation is inherent. Growth variation beyond the genetic factor is caused by communal holding and, bad water conditions. Further increase in variation as a consequence of communal holding in a static water system was observed under low and high food ration. A limited food supply does not increase growth variation, but rather decreases it. Compared to individually held yabbies given a flow through system, communal holding, poor water conditions and low food levels increase the variation in moulting frequency.

No specific chemical inhibitory to the growth of yabbies is produced in response to communal holding. Variation seems to be the result of growth inhibition of the smaller yabbies as a consequence of communal holding and high metabolite levels and a compounding effect of these factors in the communal static water treatment.

Mortality under a communal holding situation was 32.5%, 25%, 5% and 5% in flowing water (high ration), static water (high ration), flowing water (low ration) and static water (low ration) respectively. As the moulting frequencies of these treatments were 3.00 and 2.94, 1.84 and 1.89 moults per animal per experimental period, mortality in a communal system is proportional to the moulting frequency. The relevance of these studies to the aquaculture of C. destructor is discussed.

SIZE SELECTIVE PREDATION BY THE BACKSWIMMER *Anisops deanei* BROOKS ON DIFFERENT MORPHS OF *Daphnia* FROM FRESHWATER PONDS

J. Reynolds, B.Sc. Honours Thesis, 1980

Supervisor: Dr. M.C. Geddes

The predatory behaviour of the aquatic bug Anisops deanei was investigated in controlled laboratory conditions, to determine if size-selective predation by Anisops spp. will determine the morphology of Daphnia in the field. Preliminary investigation of two adjacent Daphnia populations in the field showed that seasonal growth of cephalic crests correlated with the abundance of Anisops, and that asyncronous crest development between populations correlates with an unequal distribution of Anisops predators between habitats.

Laboratory studies show that A. deanei shows a strong preference for Daphnia smaller than 2 mm in size, although it is physically capable of taking Daphnia of all sizes. Predation in the laboratory was only successful during darkness.

Crest production similar to that observed in the field was induced by the presence of A. deanei. Individuals of the preferred (<2 mm) size range taken from a wholly crested population are however just as vulnerable to predation.

The implications of these laboratory results to the field dynamics of Daphnia are discussed, as is the utility of the equations used in this study to describe mathematically the observed results.

PLANKTON OF THE MURRAY-DARLING RIVER SYSTEM, WITH PARTICULAR REFERENCE TO THE ZOOPLANKTON

R.J. Shiel, Ph.D. Thesis, 1981

Supervisors: Dr. K.F. Walker and Professor W.D. Williams

The Murray-Darling river system drains one-seventh of the Australian continent (>1 x 10^6 km^2), yet carries only 2% of the annual runoff (21 mm yr^{-1}). The two rivers have distinctly different hydrology, geology and geomorphology, which reflect in physical, chemical and biological differences. The Darling has peak flows resulting from summer monsoons in the north of the basin, the Murray has peak flows in winter and spring following winter rains and spring snow melt in the south of the basin. Contrasts have been enhanced by successive impoundment of the Murray and tributaries. The Darling is relatively unimpounded.

This study investigated the plankton of the two river systems; the limnoplankton of headwater reservoirs, plankton of lentic habitats on the floodplain (billabongs), and the potamoplankton of the lower Murray below the Murray-Darling confluence.

More than 400 taxa of Rotifera, Cladocera, Copepoda and Ostracoda were recorded from Murray-Darling waters. Half of these were new records from the continent, with 22 taxa new to science. Common rotifer genera were cosmopolitan

(e.g. Asplanchna, Brachionus, Keratella, Filinia, Polyarthra, Synchaeta), with endemic species in several genera. 90% of rotifers recorded were cosmopolitan. Common cladocerans included the genera Alona, Chydorus, Bosmina, Ceriodaphnia, Daphnia (35% endemism). Copepods (e.g. Boeckella, Calamoecia, Mesocyclops) consisted of predominantly endemic or Australasian calanoids, and cosmopolitan cyclopoids.

Physico-chemical features of habitats investigated are given. Discrete plankton assemblages were recorded for each of 23 reservoirs and 38 billabongs studied. Fluctuations in limnoplankton composition were related to physico-chemical variables, storage depth and retention time. Long retention time reservoirs (e.g. Eildon, Hume) had a stable limnoplankton dominated by microcrustacea (dominants Bosmina, Diaphanosoma, Boeckella, Calamoecia). Short retention time storages (e.g. Goulburn Weir, Mulwala) had an unstable plankton dominated by rotifers. Limnoplankton densities were lowest in oligotrophic reservoirs (e.g. Eucumbene, $\bar{x}$ zooplankton 13.0 ℓ^{-1}), highest in seasonally eutrophic storages, (e.g. Burrinjuck, $\bar{x}$ 567 ℓ^{-1}). Species diversity was lowest in the latter storages during dense algal blooms, highest in shallow impoundments with marginal hydrophyte growth, i.e. a result of pseudoplanktonic incursions (e.g. Goulburn Weir). Although a small group of eurytopic and widely distributed zooplankters was recorded from most reservoirs, on any sampling date there were different species dominants, density and diversity in even adjacent habitats, i.e. responses to local environmental variables.

With few exceptions (e.g. Rocky Valley Dam), reservoirs supplied plankton to downstream rivers. There was evidence of avoidance of outflows by microcrustacea; rotifers dominated upstream and middle reaches of the Murray and Darling tributaries. Dominant phytoplankters were, seasonally, detached epibenthic diatoms, with Volvox and blue-green algae most common in slower flows of summer.

Inoculation from fringing hydrophytes and billabongs occurred downstream. Billabong plankton and littoral microfaunal communities were the richest yet recorded (>100 rotifer and microcrustacean taxa from a single Goulburn billabong). Murray billabongs had less diverse communities. Differences were related to man's interference. Plankton densities in billabongs were invariably higher than in the nearby river or upstream reservoirs. Dominant species generally were not those of either habitat.

Shallow meso- to eutrophic impoundments on middle reaches of the Murray had features of both billabongs and lakes. From these, seasonal algal blooms accompanied by a lacustrine plankton moved downstream. The predominant zooplankters were microcrustaceans (Alona, Chydorus, Bosmina, Ceriodaphnia, Daphnia, Simocephalus, Boeckella, Calamoecia).

In contrast, the Darling, unimpounded for 2700 km, had a distinctive rotifer potamoplankton dominated by tropical species of Brachionus, Keratella, Filinia, with up to 35 rotifer species present on any date. Phytoplankters were sparse, possibly due to characteristic high abiogenic turbidity. Although continuously inoculated into the lower Murray, most pronounced pulses of Darling potamoplankton occurred in autumn, i.e. floods from summer rains in the north of the catchment took several months to reach the Murray.

Seasonal fluctuations in plankton composition in the lower Murray reflected the disproportionate contributions from the two rivers, i.e. a predominantly

microcrustacean limnoplankton from Murray flows, with blooms of blue-green algae (Anabaena/Anacystis) in summer, and diatoms (Cyclotella/Melosira) in winter and spring, and a plankton dominated by typically warm stenothermal pantropical rotifers from the Darling with, seasonally, waters of high abiogenic turbidity and low algal biomass.

One hundred and thirty-three taxa were recorded from the lower river zooplankton; half of these were pseudoplanktonic or littoral incursion species flushed in by floods, or accompanying algal blooms. Of the dominant potamoplankters, approximately half were endemic or Australasian in distribution, i.e. a characteristic and autochthonous Murray potamoplankton assemblage. Plankton density and diversity was markedly contagious both across the river and longitudinally, with localised pulses in response to point source nutrient inflows. Both density and diversity increased downstream. Mean zooplankton density recorded at Mannum, S.A., was 119 ℓ^{-1}, average momentary species composition was 14.4 rotifers, 6.0 cladocerans and 2.4 copepods. Correlation coefficients derived by linear regressions of plankton density and diversity on measured environmental variables indicated that temperature, salinity and turbidity significantly influenced some of the predominant taxa. Most common taxa were eurytopic, recorded over a wide range of water quality across the basin. Most of the cosmopolitan taxa, particularly Rotifera, are regarded elsewhere as indicators of eutrophy.

TAXONOMY, ECOLOGY AND PALAEOECOLOGY OF OSTRACODS FROM AUSTRALIAN INLAND WATERS

P. De Decker, Ph.D. Thesis, 1981

Supervisor: Professor W.D. Williams

The taxonomy of ostracods from Australian inland waters is reviewed. Three new genera and 21 new species are described and 24 other species re-examined (13 of which are re-described). Notes on the ecology and distribution of Australian non-marine ostracods are provided. There is a high diversity of endemic halobiont species, most of which are planktic. Some elements of the freshwater fauna are endemic, some of which belong to genera found elsewhere, and a number of species are found in New Zealand. Part of the temporary pool fauna consists of cosmopolitan species.

To introduce the palaeolimnological studies, a classification of waterbodies in Australia is provided to assess the best sites for palaeoecological and palaeoclimatological investigations. An examination of the sort of information fossil ostracods can provide is also presented.

To trace past histories of selected lakes, 1,241 samples from Quaternary lacustrine sediments from south eastern Australia are examined for their fossil ostracod remains. From these samples, 12 ostracod species are described, 3 of which are new.

Ostracods and other fossil remains are studied from cores from 4 maar lakes in western Victoria. Results indicate that water salinity of 2 of these lakes (Gnotuk and Keilambete) varied during the Holocene, usually synchronously. As these changes in water salinity relate to water levels, this information follows the postulated changes of levels for the deeper and less saline Lake

Bullenmerri. Little information is available from the fourth Lake Purrumbete core as water level remained high and no ostracods are recovered. The data for Lake Keilambete compare well with previous published data from sediment analyses.

The study of ostracods from a profile at Pulbeena and Mowbray Swamps in north western Tasmania provides information on waterflow from springs at both sites for the last 80,000 and 110,000 years respectively. The data are consistent with the previous palynological information from aquatic plants.

The ostracods extracted from a core at Lake George in New South Wales define the presence of high water level phases in the lake for the last 70,000 years. This information differs for some periods with the previous sedimentological and palynological data.

The ostracods taken from a short core at Pillie Lake, situated near the coast in South Australia, indicate changes in water salinity and from permanent to ephemeral water conditions. This change is thought to be related to sea level regression. Additionally, the ostracod fauna demonstrates the unusual formation of dolomite under permanent water conditions.

Changes in lake levels and water flow are then considered in broad climatic terms for south eastern Australia for the Lake Pleistocene and Holocene. Brief comparison with changes in lake levels for the same period in Africa shows a similar pattern to the one registered in Australia but with a shift in time of the order of 1,000-2,000 years.

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